

Oxy variables

Oxygenator variabelen

$d := 0.038$

$A_f := 23$

$Bloodpath := 16$

$p := .5416$

$\phi := 0.620$

Values calculated

$\psi := 0.789$

Oxy variables

See below

 Ссылка:C:\Users\O2 dissociatie.xmcdz(R)

This worksheet is not yet completed

waterdampspanning

Omrekening van ingangsvariabelen naar geschikte eenheden voor model

$$Chb := \frac{Hgb}{100}$$

$$Hct := Chb \cdot 3$$

$$Q := \frac{Qb}{60}$$

Waterdampspanning

Met behulp van dit programma kan men de waterdampspanning voor een gegeven temperatuur berekenen door lineaire interpolatie.

De data komen uit deel 3 van Ciba Geigy.

Men vult de temperatuur in achter "data" en krijgt de uitkomst.

$$\text{kPa} := Pa \cdot 10^3$$

$$\text{degC} \equiv 1$$

$$C(T) := \left(\frac{T}{K} - 273.15 \right) \quad C(373.15 \cdot K) = 100 \cdot \text{degC}$$

10		1.227
11		1.312
12		1.402
13		1.497
14		1.598
15		1.704
16		1.817
17		1.937
18		2.063
19		2.196
20		2.337
21		2.486
22		2.643
23		2.809
24		2.983
25		3.167
26		3.361
27	Temp :=	3.565
28	.degC	3.78
29		4.006
30		4.243
31		4.493
32		4.755
33		5.031
34		5.32
35		5.624
36		5.942
37		6.276
38		6.626
39		6.993
40		7.378
41		7.78
42		8.202
43		8.642
44		9.103
45		9.586

temp := Ta

Tcor_waterdamp := linterp(Temp , P , temp) Tcor_waterdamp = 36.701 · torr

$$Pb := \frac{[(\text{Barometerdruk} - T_{cor_waterdamp}) \cdot \left(\frac{FiO_2}{100}\right)]}{\text{torr}} \quad Pb = 328.095$$

waterdampspanning

Omrekening PO2 naar reële T

Omrekening van de PvO2 naar de reële temperatuur

$$\text{Temp.} := 37$$

$$pHa := 7.37$$

$$pHv := 7.342$$

$$n := 2.7$$

$$P'50a := [26.6 \cdot 10^{[.48 \cdot (7.4 - pHa)]}]$$

$$P50a := [P'50a \cdot 10^{[.024 \cdot (37 - \text{Temp})]}] \quad P50a = 27.497$$

$$P'50v := [26.6 \cdot 10^{[.48 \cdot (7.4 - pHv)]}]$$

$$P50v := [P'50v \cdot 10^{[.024 \cdot (37 - \text{Temp})]}] \quad P50v = 28.361$$

$$P50 := \frac{P50a + P50v}{2} \quad P50 = 27.929$$

$$Sv := \frac{\left(\frac{PvO_2}{P50v}\right)^n}{1 + \left(\frac{PvO_2}{P50v}\right)^n} \quad Sv = 0.779$$

$$P'50a := [26.6 \cdot 10^{[.48 \cdot (7.4 - pHa)]}]$$

$$P50a_{cor} := [P'50a \cdot 10^{[.024 \cdot (37 - Ta)]}] \quad P50a_{cor} = 21.443$$

$$P'50v_{cor} := [26.6 \cdot 10^{[.48 \cdot (7.4 - pHv)]}]$$

$$P50v_{cor} := [P'50v \cdot 10^{[.024 \cdot (37 - Ta)]}] \quad P50v_{cor} = 22.117$$

$$P50_{cor} := \frac{P50a_{cor} + P50v_{cor}}{2} \quad P50_{cor} = 21.78$$

$$PvO2_{cor} := \exp\left[\frac{\ln\left[\frac{-Sv}{(Sv - 1)}\right]}{n}\right] \cdot P50v_{cor} \quad PvO2_{cor} = 35.248$$

$$Sv_{cor} := \frac{\left(\frac{PvO_2}{P50v_{cor}}\right)^n}{1 + \left(\frac{PvO_2}{P50v_{cor}}\right)^n} \quad Sv_{cor} = 0.873$$

Omrekening PO2 naar reële T

Berekening massatransport

Berekeningen van massatransport

Oplosbaarheid van zuurstof

$$k_c := \left[(4.658 \cdot 10^{-5}) \cdot (1.01)^{37-T_a} \right] \quad k_c = 4.871 \times 10^{-5}$$

$$k_p := (2.855 \cdot 10^{-5}) \cdot 1.01^{(37-T_a)} \quad k_p = 2.986 \times 10^{-5}$$

$$k := [k_c \cdot Hct + k_p \cdot (1 - Hct)] \quad k = 3.557 \times 10^{-5}$$

$$PvO_2cor_0 := PvO_2_{cor} \quad PvO_2cor_0 = 35.248$$

$$\lambda(PvO_2cor) := \frac{1.34}{k} \cdot Ch_b \cdot \frac{n}{P50_{cor}} \cdot \left(\frac{PvO_2cor_0}{P50_{cor}} \right)^{(n-1)} \cdot \frac{1}{\left[1 + \left(\frac{PvO_2cor_0}{P50_{cor}} \right)^n \right]^2} \quad \lambda(PvO_2cor) = 49.053$$

Diffusie van zuurstof in het bloed

$$D_c := 0.76 \cdot 10^{-5} \cdot 1.025^{(T_a-25)} \quad D_c = 9.146 \times 10^{-6}$$

$$D_p := 1.62 \cdot 10^{-5} \cdot 1.025^{(T_a-25)} \quad D_p = 1.95 \times 10^{-5}$$

$$N := \frac{k_c}{k_p} \quad N = 1.632$$

$$\beta := \left[\frac{1}{3} \left[\left[\frac{2}{1 + \left(\left(N \cdot \frac{D_c}{D_p} - 1 \right) \right) \cdot \left(\frac{0.283}{2} \right)} + \frac{1}{1 + \left(N \cdot \frac{D_c}{D_p} - 1 \right) \cdot (1 - 0.283)} \right] \cdot \left(N \cdot \frac{D_c}{D_p} - 1 \right) \right] \right] \quad \beta = -0.256$$

$$\chi := - \frac{\left(N \cdot \frac{D_c}{D_p} - 1 \right) - \left(N \cdot \frac{D_c}{D_p} \right) \cdot \beta}{\left(N \cdot \frac{D_c}{D_p} - 1 \right) - \beta} \quad \chi = 1.833$$

$$R := \left[Hct \cdot \frac{\left(N \cdot \frac{D_c}{D_p} - 1 \right)}{\left(N \cdot \frac{D_c}{D_p} + \chi \right)} \right] \quad R = -0.027$$

$$D := \left(D_p \cdot \frac{k_p}{k} \cdot \frac{1 + \chi \cdot R}{1 - R} \right) \quad D = 1.513 \times 10^{-5}$$

$$D_{eff} := \begin{cases} \lambda_p \leftarrow \lambda(PvO2cor) \\ \frac{D}{1 + \lambda_p} \end{cases} \quad D_{eff} = 3.023 \times 10^{-7}$$

Densiteit van bloed

$$\rho_c := 1.09$$

$$\rho_p := 1.035$$

$$\rho := [\rho_c \cdot Hct + \rho_p \cdot (1 - Hct)] \quad \rho = 1.05167$$

Viscositeit van bloed

Absolute bloedviscositeit

$$\eta_p := \frac{\exp\left[-5.64 + \frac{(0.18 \cdot 10^4)}{(Ta + 273)}\right]}{100} \quad \eta_p = 0.01287$$

$$\eta := \eta_p \cdot \exp(2.31 \cdot Hct) \quad \eta = 0.02591$$

Kinematische viscositeit

$$\nu := \frac{\eta}{\rho} \quad \nu = 0.02463$$

Dimensioleze getallen

$$Nre := \frac{Q \cdot d}{(1 - p) \cdot A_f \cdot \nu} \quad Nre = 10.132$$

$$Nsc := \frac{\eta}{\rho \cdot D} \quad Nsc = 1.628 \times 10^3$$

Berekening massatransport

Differentiaalvergelijking

Differentiaalvergelijking

$$a := \left[\frac{4}{p} \cdot \left[\frac{(1-p)}{d} \right]^{(1+\psi)} \cdot \left(\frac{Af \cdot \eta}{Q \cdot \rho} \right)^\psi \cdot \frac{\phi}{2} \cdot \left(\frac{\nu}{D} \right)^{\frac{2}{3}} \right]$$

$a = 0.108$

$$D(x, PvO2cor) := \begin{cases} \lambda_p \leftarrow \lambda(PvO2cor) \\ a \cdot \frac{Pb - PvO2cor_0}{\left(1 + \lambda_p\right)^{\frac{2}{3}}} \end{cases}$$

Z := rkfixed(PvO2cor, 0, Bloodpath, 25, D)

	0	1
0	0	35.248
1	0.408	36.22
2	0.816	37.234
3	1.224	38.294
4	1.632	39.406
5	2.04	40.572
6	2.448	41.799
7	2.856	43.091
8	3.264	44.455
9	3.672	45.898
10	4.08	47.427
11	4.488	49.051
12	4.896	50.779
13	5.304	52.622
14	5.712	54.592
15	6.12	...

$Z_{25,1} = 89.224$

Z =

Differentiaalvergelijking

p = .41241

Porosity of the fiber bundle

Bloodpath = 10.2

Blood path length [cm]

Af = 21.55

Frontal area [cm²]

Barometerdruk = 765.8torr

Barometric pressure [mmHg]

FiO2 = 45

Inspired O₂ fraction [%]

Qb = 4990

Blood flow [mL/min]

Ta = 32.5

Blood temperature [°C]

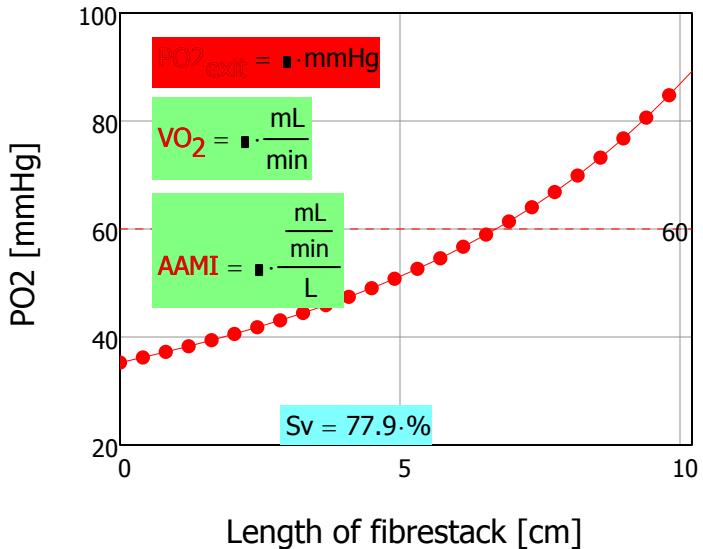
Hgb = 10.1

Hemoglobin concentration [g/dL]

PvO2 = 45.2

Partial venous O₂ tension [mmHg]

Increase in partial oxygen tension



$$e\text{FiO}_2 := \frac{\text{FiO}_2}{100} - \left(\frac{\text{PO}_2_{\text{exit}}}{\text{Barometerdruk}} \right) + 0.21 = \blacksquare$$